LISTING OF CLAIMS

1. (Currently Amended) A method of forming a tungsten film on a semiconductor substrate, the method comprising:

(a) depositing a tungsten nucleation layer on the semiconductor substrate;

(b) depositing a tungsten bulk layer on the nucleation layer using a chemical vapor deposition (CVD) process; and

(c) depositing a tungsten cap layer having a thickness between about 50 and 200 angstroms on the tungsten bulk layer using a pulsed nucleation layer (PNL) deposition technique; wherein the tungsten film stack is terminated by a tungsten cap layer and said cap layer reduces the roughness of the tungsten film stack.

2. (Original) The method of Claim 1, further comprising repeating (b) and (c).

3. (Original) The method of Claim 1, further comprising repeating (b) and (c) multiple times.

4. (Original) The method of Claim 1, wherein (a) comprises:

positioning the semiconductor substrate in a reaction chamber;

heating the semiconductor substrate; and

performing PNL on the semiconductor substrate using a tungsten-containing gas and a reducing gas.

5. (Original) The method of Claim 4, wherein the reducing agent is a silane.

6. (Original) The method of Claim 1, wherein (b) comprises exposing the semiconductor substrate to a process gas comprising one or more of the following:

WF_6-H_2, WF_6-B_2H_6, and $W(CO)_6$.

7. (Original) The method of Claim 1, wherein (c) comprises:

(i) flowing a reducing gas into a deposition chamber holding the semiconductor substrate, whereby the reducing gas is adsorbed onto said semiconductor substrate;

(ii) purging the reducing gas from the deposition chamber;

(iii) flowing a tungsten-containing gas into said deposition chamber, whereby said deposited reducing gas is substantially reduced to a tungsten film;

(iv) purging the tungsten-containing gas from the deposition chamber; and

(v) repeating (i) through (iv) for one or more additional cycles.

8. (Original) The method of Claim 7, wherein the reducing gas is a silane.

9. (Previously Presented) A method of forming a tungsten film on a semiconductor substrate, the method comprising:

(a) depositing a tungsten nucleation layer on the semiconductor substrate by contacting the semiconductor substrate with multiple cycles of alternating pulses of a tungsten-containing gas and a reducing agent ~~in the presence of nitrogen~~; and

(b) depositing a tungsten bulk layer on the tungsten nucleation layer by a CVD process in which the semiconductor substrate is exposed to nitrogen;

wherein ~~(a) comprises delaying exposure of the semiconductor substrate to nitrogen until after deposition of the tungsten nucleation layer has begun~~ depositing the tungsten nucleation layer comprises performing at least one pulsed cycle prior to flowing nitrogen, performing one or more pulsed cycles in the presence of nitrogen, and shutting off the nitrogen flow prior to the final pulsed cycle.

10. (Original) The method of Claim 9, wherein (a) comprises performing PNL by alternating exposure of the semiconductor substrate to the tungsten-containing gas and the reducing agent.

11. (Original) The method of Claim 9, wherein the nitrogen employed in (a) comprises between about 1 and 20% by volume of the total gas flow to the semiconductor substrate.

12. (Original) The method of Claim 9, wherein the nitrogen employed in (b) comprises between about 1 and 20% by volume of the total gas flow to the semiconductor substrate.

13. (Original) The method of Claim 9, wherein (b) comprises exposing the semiconductor substrate to a tungsten-containing gas selected from the group consisting of WF_6 and $W(CO)_6$ and combinations thereof.

14. (Canceled)

15. (Currently Amended) The method of Claim 9 ~~14~~, wherein the delay between the start of the tungsten nucleation layer deposition and exposure to nitrogen is between about 0.25 and 1 second.

16. (Original) The method of Claim 9, wherein (b) comprises delaying exposure of the semiconductor substrate to nitrogen until after deposition of the tungsten bulk layer has begun.

17. (Original) The method of Claim 16, wherein the delay between the beginning of tungsten bulk layer deposition and exposure to nitrogen is between about 0.25 and 1 second.

18. (Original) The method of claim 9, wherein (a) comprises stopping exposure of the semiconductor substrate to nitrogen prior to completion of the deposition of the tungsten nucleation layer.

19. (Currently Amended) A method of forming a tungsten film on a semiconductor substrate in a reaction chamber, the method comprising:

(a) forming ~~a~~ an initial boron layer on the semiconductor substrate;

(b) contacting the substrate with a tungsten-containing precursor that is reduced to form a tungsten layer on the semiconductor substrate; ~~the boron layer with a tungsten-containing gas to thereby reduce the tungsten-containing gas to~~

(c) contacting the semiconductor substrate with a silane to form a layer of silane; and

(d) contacting the layer of silane with the tungsten-containing gas to thereby reduce the tungsten-containing gas to another tungsten layer on the semiconductor substrate.

20. (Original) The method of claim 19, wherein (a) comprises decomposing a borane compound on the semiconductor substrate.

21. (Original) The method of claim 20, wherein the borane compound is diborane.

22. (Original) The method of claim 20, further comprising heating the semiconductor substrate to a temperature of between about 200 and 400C and contacting the semiconductor substrate with the borane compound in the vapor phase.

23. (Original) The method of claim 22, wherein the vapor phase comprises a nitrogen carrier gas in addition to the borane compound.

24. (Original) The method of claim 22, further comprising purging the reaction chamber of the borane compound after contacting the semiconductor substrate with the borane compound in the vapor phase.

25. (Original) The method of claim 19, wherein the semiconductor substrate is contacted with the borane compound for a period of between about 0.1 and 10 seconds.

26. (Original) The method of claim 19, wherein the tungsten-containing gas of (b) and (d) has the same composition.

27. (Original) The method of claim 19, wherein the tungsten-containing gas of (b) comprises WF_6.

28. (Original) The method of claim 19, wherein the semiconductor substrate is contacted with the tungsten-containing gas in (b) for a period of between about 0.1 and 10 seconds.

29. (Original) The method of claim 19, wherein the layer of reducing agent formed in (c) is a self-limiting layer.

30. (Canceled)

31. (Canceled)

32. (Original) The method of claim 19, further comprising repeating (c) and (d) for at least one cycle.

33. (Original) The method of claim 32, wherein the duration of contacting with the tungsten-containing gas in an earlier cycle is shorter than the duration of contacting with the tungsten-containing gas in a later cycle.

34. (Original) The method of claim 19, wherein the duration of contacting with the tungsten-containing gas in (b) is shorter than the duration of contacting with the tungsten-containing gas in (d).

35. (Original) The method of claim 19, further comprising exposing the semiconductor substrate to a pulse of WF_6 prior to (a).